

Learning Technologies
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PROJECT DESCRIPTION

NASA's Learning Technologies Project (LT) is a NASA-wide education technology development initiative. LT supports the development of projects that deliver NASA content through revolutionary technologies to enhance education in the areas of science, technology, engineering and mathematics (STEM). Research and development are at the core of the LTP mission. The Learning Technologies Project is part of NASA's e-Education Project and is NASA's educational technology incubator. LTP seeks to enhance formal and informal education in STEM fields with the goal of increasing the number of students in those fields of study. The Learning Technologies Project combines the talents of educators, industry, academia, non-profit organizations and NASA's Mission Directorates to develop educational technologies that enable, empower, and educate learners of diverse backgrounds, characteristics, and abilities. The Learning Technologies project office is located at Goddard Space Flight Center in Greenbelt, Maryland. In FY11 there were full-time project personnel at GSFC and JSC.

PROJECT GOALS

The LT project goal is to place primary focus on advance use of technologies to help address the Agency goal to increase the completion of STEM degrees and “Strengthen NASA and the Nation’s future workforce.” LT has established a research and development direction for joint public/private industry-education ventures that target research in games and virtual worlds for learning and training, and supports the overall eEducation Roadmap and existing investment in the area of games and learning. LT’s research falls into the three broad categories of games, virtual worlds and cyberlearning (with considerable necessary overlap).

ACTIVITIES

NASA-based Massively Multitplayer Online STEM Learning Game Project is an effort to tap the power of virtual world games for the benefit of STEM learning and career exploration. This innovative project is being developed in partnership with the IPP Office using a multi-agreement, coordinated approach:

- **Developer Space Act:** In FY11 Astronaut: Moon, Mars and Beyond, LLC (Project Whitecard, Wisdom Tools and ARA/Virtual Heroes)sought private and public investments to fund development of the project. A Kickstarter campaign generated donations from 962 backers, while private investors and Canadian government tax credits generated close to \$1M.
- **Education Cooperative Agreement:** A team led by Challenger Learning Centers completed a year of research to inform the development of the game.

- **Subject Matter Experts:** LT began identifying subject Matter Experts (SME) from across the agency to work with the development and education teams on MMO content.
- **Evaluation Cooperative Agreement:** SRI began development of tools to perform independent evaluation of the effectiveness of the MMO.

A primary research topic for the LT Research Roadmap was a diversity and inclusion research component to ensure that all communities are inspired and engaged with LT outcomes. With the CAN collaboration with Challenger Centers, LT provides specific guidelines to help ensure that the NASA MMO game designs and modules are designed to intentionally engage a diverse set of players (e.g., various ages, race and ethnicity representations, educational backgrounds, and ability levels) in a range of STEM topics, fields, and areas of study. The goal is to also ensure that the specific affective elements within the game are valid and appropriate for gaining the interest of all students. Through a partnership with Benedict College and a group of diverse Challenger Learning Center communities, who represent diverse groups of students and educators, the NASA MMO Diversity Team has developed a document to provide guidance to designers and developers on the team as well as to help serve as a benchmark, along with other resources in this area, to help ensure that diversity is both honored and promoted in the game, as well in the educational materials that support the game.

Moonbase Alpha was developed as a proof of concept demonstration game to show that NASA content (Lunar Architecture) could be combined with a state-of-the-art game engine (Unreal Engine 3) to create an engaging game that is commercial quality, inspirational and fun. The game has been downloaded more than 440,000 times since its release in July 2010.

- **Expand Access:** In FY11, LT planned to develop a non-Steam based version of Moonbase Alpha to make access easier for users in environments with download restrictions, but was unable to do so because of budget restrictions. Those plans will be revived in FY12 depending on funding availability.
- **Curricular Materials:** Support material for using Moonbase Alpha with students in classrooms was developed in FY11 by a team of FIRST engineers and scientists who worked with teachers at NASA Langley. The draft curriculum is being reviewed externally through the Immersive Education initiative.

NASA eEducation Roadmap: LT supported the continued dissemination and use of the eEducation strategic research roadmap to identify key eEducation research questions and technical requirements. LT continued to build networks and partnerships across NASA, with other Federal agencies and commercial and academic organizations in the area of virtual worlds. In FY11, work on a new roadmap began that will add cyberlearning, mobile computing devices to existing focus areas when completed in FY12.

Virtual Worlds: LT maintained NASA eEducation Island as an outpost in the virtual world Second Life. The island facilitated LT virtual world research and acted as a launching point for supporting other NASA education efforts. In FY11, LT supported INSPIRE and Informal Education's Miami Science Museum Teen Expo and facilitating an in-world appearance by NASA Education AA Leland Melvin.

Digital Badge Initiative: LT worked closely with the LEARN project and the Office of Education to coordinate NASA's efforts on digital badges. Digital badges are being explored as alternative skill credentialing tools in the Digital Learning and Media competition sponsored by the MacArthur Foundation with NASA and other federal agencies participating as content collaborators.

- Supported the submission of NASA's content collaboration proposal to the Badges for Lifelong Learning competition.
- Facilitated multi-agency meetings with the Mozilla Foundation to expand participant understanding of the Open Badge Infrastructure designed by Mozilla.

PROJECT BENEFIT TO OUTCOME

The NASA-based massively multiplayer online STEM learning game project will eventually contribute to Outcome 2 in the area of providing NASA resources for students. The project currently benefits Outcome 2 in the following areas:

2.3.3 Number of approved materials that are electronically accessible

2.3.4 Customer satisfaction data regarding relevance of NASA educational resources.

2.3.5 Customer satisfaction data regarding effectiveness of NASA educational resources.

2.3.6 Use of technology to improve data collection, reporting strategies & dissemination

In addition, activities address objectives 1.1, 1.3 and 3.1 and PART measures regarding the number of individuals reached through eEducation media.

PROJECT ACCOMPLISHMENTS

Evidence that Learning Technologies has helped develop NASA's leadership role in national STEM improvement efforts can be seen through invitations to the project management team to address national conferences in 2011. LT was invited and participated in two panels at NOAA's inaugural Summit on Gaming and Simulation and gave the keynote address at the 2011 Immersive Education Summit. The project was also selected to present at Federal Consortium for Virtual Worlds 2011, the National Science Teachers Association annual conferences, NASA's IT Summit and International Society for Technology Education annual conference in 2011. In addition Laughlin's chapter "Overcoming Objections to MUVes in Education" was published in Vincenti and Braman's book Teaching through Multi-User Virtual Environments.

Learning Technologies released a draft curriculum to support the Moonbase Alpha game in 2011. The curriculum was developed by a team of scientists and engineers at NASA Langley working with teachers and is being reviewed by the Immersive Education Initiative curriculum working group. The draft document has been downloaded more than two thousand times, but the project lacks direct data for usage beyond a dozen test cases. The Moonbase Alpha game won the Serious Game of the Year (government) award at the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) 2010 conference. LT team members at GSFC and JSC along with MSFC Academic Affairs

Office, the Army Game Studio and ARA/Virtual Heroes won a NASA group achievement award for Moonbase Alpha. The game is featured in the visitor center at Stennis and has been downloaded more than 440,000 times since its release in 2010.

Learning Technologies and its partners on the NASA-themed MMO project won the STEM award from the Mid-Atlantic division of the Federal Laboratory Consortium in 2011 for innovative work in STEM education. LT's virtual world project "NASA eEducation Island" in Second Life won awards for "best education project" and "best science and technology destination" in 2011. The LT webpage on the NASA Portal has been in the top three entry pages among offices every month since July 2010 (sharing the top slots with the Office of Chief Technologist and Human Space Flight RSS feed).

PROJECT CONTRIBUTIONS TO PART MEASURES

Individuals reached through NASA eEducation Resources:

The Learning Technologies website:

- 889,176 Web Hits
- LT remains one of the top three "offices" by page views

NASA eEducation Island in Second Life

- 17192 Second Life visitors
- 34% increase from FY10 (reversing decline of 12% from FY09)
- 16.36 minutes average visit

Moonbase Alpha

- 237,112 downloads
- 36 minutes average engagement time

Efficiency

- \$0.47 per interaction*
- 29% reduction from FY10

**Interaction cost is calculated using the NETS method of dividing the total number of interactions by the full project budget.*

LT has been in the top three entry pages among offices every month for nine months. LT is currently third behind only the Office of Chief Technologist and Human Space Flight.

IMPROVEMENTS MADE IN THE PAST YEAR

Implementing non-reimbursable Space Act Agreements is a primary collaboration vehicle that brings industry partners with funding and a vision for partnering with NASA to LT to promote the goals and outcomes of the roadmap and the Office of Education APGs. LT provided guidance on several non-reimbursable space act agreements based on experience developed for the MMO activity. That experience was also put to use supporting the Partnership and Programmatic Implementation working groups in FY11. LT continued strong collaborative ties with the Innovative Partnerships Program Office and worked to build relationships in the Chief Technologists Office.

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- Astronaut: Moon, Mars and Beyond, LLC (Virtual Heroes/ARA, Project Whitecard and Wisdom Tools, Inc.) are partner with LT develop the NASA-based massively multiplayer online STEM learning game.
- Georgia Tech's Sonification Lab worked with LT's Math Description Engine Software Development Kit to create a "lite" desktop version of MathTrax, the accessible graphing calculator program previous developed under LT.
- Valve, the owner of the Steam game distribution and support network. LT has an agreement with Valve to distribute Moonbase Alpha.
- The Hypatia Project is focused on promoting STEM learning among women and girls through virtual worlds and began partnering with LT in 2011 to repurpose existing virtual assets to support Hypatia's programming.
- Miami Science Museum on their NASA Informal Education grant to facilitate migration of their existing Second Life Teen Grid Resources to the Main Grid and to coordinate planning for their second year of funding. MSM has created a virtual NASA Youth Expo to highlight NASA missions and accomplishments in Second Life with a focus on teens.
- The JSC Learning Technologies team on all elements of Second Life work and research and virtual worlds' accessibility research.
- The GSFC Innovative Partnership Program Office partners with LT on the NASA-themed MMO project.
- LT has been working closely with NOAA on virtual worlds research and applications.
- The Army Game Studio collaborated on the development and public relations surrounding Moonbase Alpha.
- The Challenger Center for Space Science Education has joined the LT team with a Cooperative Agreement to engage teachers and students throughout their network with our MMO STEM education research.
- SRI evaluation has joined the LT team with a Cooperative Agreement to evaluate our STEM engagement and motivation goals for the MMO along with assessing the learning impacts of the MMO.
- NASA Johnson's Educator Resource Center at Space Center Houston began staffing a virtual ERC on NASA eEducation Island in Second Life. Learning Technologies is providing virtual office space, communications tools and other assistance to the ERC coordinator to expand their in-person services to educators who may not be able to travel to an ERC in the physical world.
- LT established a Citizen Scientist project in conjunction with faculty from the University of South Florida Institute for Marine Remote Sensing and GSFC Earth Science Oceans Data Team entitled Cyberlearning: Remote Sensing and Environmental Sensors at the NASA eEducation island in Second Life. This 3D project demonstrates the collection and use of MODIS data from the NASA Aqua satellite using a sky-based satellite, an ocean-based buoy for data collection and an information kiosk.